The biomass of *Corbula* and *Corbicula* in the low salinity zone in August 2011

Interagency Ecological Program
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Corbula amurensis

Corbicula fluminea

Question:

Did high flow events in the spring of 2011 result in significant changes in the biomass of the invasive bivalves *Corbula amurensis* and *Corbicula fluminea* in the low salinity zone (LSZ) in August, relative to previous sampling events?

Background:

Invasive clams in the estuary

- Primary production lost to invasive bivalve grazing is likely a key factor limiting productivity in the San Francisco estuary (estuary). Declines in several species of calanoid copepods and mysid shrimp have been attributed to competition with bivalves for food, as well as bivalves' direct consumption of copepod nauplii (Kimmerer et al. 1994, Orsi and Mecum 1996).
- Two dominant bivalve species:
  - ❖ ***Corbula amurensis (Corbula)*** : abundant and widespread throughout brackish and saline regions of estuary
  - ❖ ***Corbicula fluminea (Corbicula)***: abundant and widespread in freshwater regions of the upper estuary
- Changes in freshwater outflow patterns in the estuary alter the spatial distributions and biomass of *Corbula* and *Corbicula* populations. High outflows are expected to correspond with lower *Corbula* abundances in the LSZ.
  - ❖ 2011 was a significantly wetter year than the three years preceding it (Table 1).

Table 1. Percent (%) of average flows based on water year type index, and official water year classification for water years (WY) 2008-2011

Water Year	Sacramento Valley, % of average flows (WY Type)	San Joaquin Valley ,% of average flows (WY Type)
2008	62% (C)	63% (C)
2009	69% (D)	83% (D)
2010	85% (BN)	85% (AN)
2011	128% (W)	170% (W)

Water Year Classification: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry. C=Critical. All data are from CDEC.

GRTS benthic special study

- Benthic sampling begun by DWR's Bay Delta Monitoring and Analysis section (BDMA) in 2007
- 175 sites sampled annually in May and October
- Sites selected using Generalized Random Tessellation Stratified (GRTS) design (Stevens and Olsen 2004)
- Sites in LSZ re-sampled in August 2011 for *Corbula* and *Corbicula*

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References

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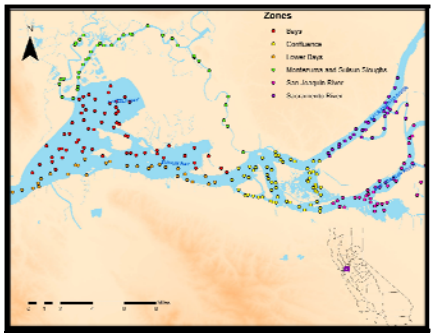


Figure 1. Prior to running statistical analyses on all GRTS biomass data, sites were coarsely grouped into one of six zones, based on habitat characteristics and geographic location.

Methods:

Field

- 141 sites sampled in the LSZ (river km 55-100) with Ponar dredge; samples rinsed and preserved in the field

Lab

- All *Corbicula* (n=3,713) and *Corbula* (n=2,826) picked out of samples and measured, either by calipers or by Image Analysis software
- 7 stations had an extra grab from which live *Corbicula* and *Corbula* were picked out of the samples (live sort), measured, dried and ashed to obtain biomass

Analyses

- Shell length and biomass data from the live sorted clams were used to generate regression equations for converting size classes of preserved clams from each site to biomass
- Kruskal-Wallis (KW) tests run on biomass data by zone (Figure 1) for all sampling events with available biomass data to determine whether biomass differed significantly ($p<0.05$) between sampling events

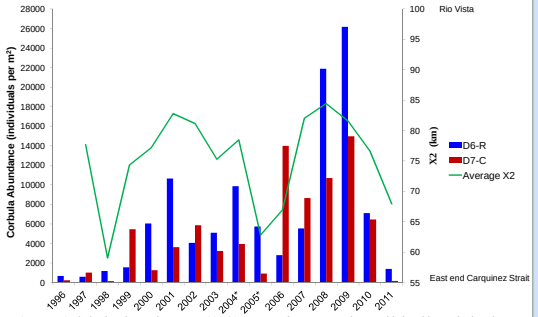


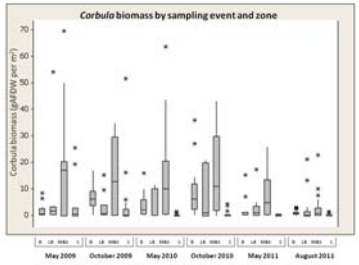
Figure 2. Mean *Corbula* abundances in August 1996-2011 at two of BDMA's regular monthly benthic monitoring sites: D6 (in Suisun Bay near Carquinez) and D7 (middle of Grizzly Bay) plotted relative to mean X2 (distance from the Golden Gate to the 2 psu bottom salinity isohaline) for the previous 2 months. *2004 and 2005 sampled in July.

Results and Conclusions:

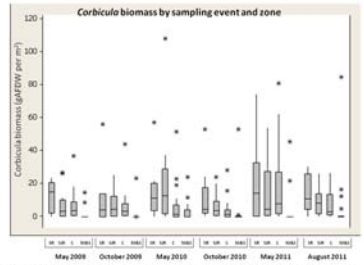
Corbula: For zones with significant results, KW post test found these sampling events to be significantly different from each other:

Bay	**Montezuma and Suisun Sloughs**
Oct 2009 vs. May 2011;	Oct 2010 vs. August 2011
Oct 2010 vs. May 2011	
Oct 2009 vs. August 2011	
Oct 2010 vs. August 2011	**Confluence**
Oct 2009 vs. May 2009	August 2011 vs. May 2009
	May 2010 vs. May 2009

Corbicula
KW test found no significant differences in biomass between sampling events for any zone



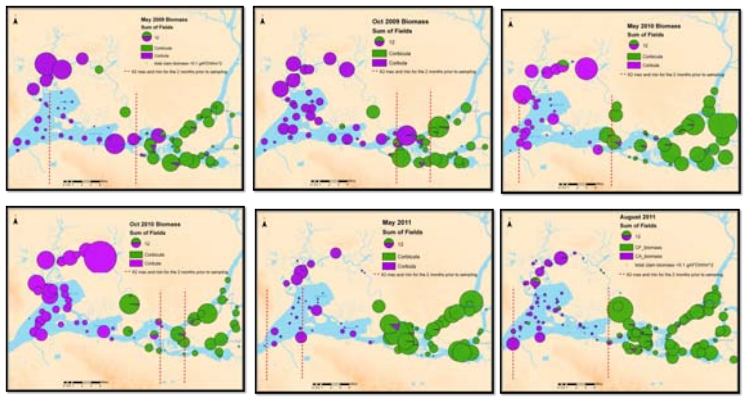
B=Bays; LB=Lower Bays; M&S=Montezuma and Suisun Sloughs; C=Confluence



SR=Sacramento River; SJR=San Joaquin R.; C=Confluence; M&S=Montezuma and Suisun Sl.

- Long term trends in *Corbula* abundances at the 2 regular benthic monitoring sites in the Bay zone in August (Figure 2) support the finding of fewer *Corbula* in the Bay zone in 2011.
- Interestingly, *Corbula* biomass was not found to be significantly different between sampling events in the Lower Bay zone, another zone with historically high *Corbula* biomass.
- *Corbicula* was found much farther west in August 2011 than in previous GRTS events, suggesting its range expands with high freshwater flows

Distribution of *Corbula* and *Corbicula* biomass at six GRTS sampling events



Future directions:

- Calculate biomass for May/Oct 2007 and 2008 sampling events; rerun analyses.
- Examine the specific mechanisms that may influence *Corbula* and *Corbicula's* biomass in wet versus dry years. Is it only salinity? What about temperature? Food availability? Turbidity? Flow velocity?